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FLOOD INSURANCE STUDY

ORIGINAL

COMPLETED
24

CITY OF WINFIELD, MISSOURI

LINCOLN COUNTY

MAY 17, 1982

Federal Emergency Management Agency

COMMUNITY NUMBER - 290213

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PUBLISHED SEPARATELY:

Flood Insurance Rate Map

FLOOD INSURANCE STUDY

CITY OF WINFIELD,
LINCOLN COUNTY, MISSOURI

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Winfield, Lincoln County, Missouri, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert the City of Winfield to the regular program of flood insurance by the Federal Emergency Management Agency (FEMA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these Federally-supported studies are based. These criteria take precedence over the minimum Federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.3 (d). In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by the U.S. Army Corps of Engineers, St. Louis District, for the Federal Emergency Management Agency, under Inter-Agency Agreement No. IAA-H-9-79, Project Order No. 36 and 2nd Amendment, thereto. This study was completed in November 1980.

1.3 Coordination

Attended by representatives of the City of Winfield, FEMA and the Study Contractor, the initial Consultation Coordination Officer (CCO) meeting was held November 28, 1978 to explain the nature and purpose of the Flood Insurance Study.

On May 1, 1980, the results of the work by the Study Contractor were reviewed at an intermediate meeting attended by representatives of the Study Contractor, FEMA, and the community.

On October 13, 1981, the results of the work by the Study Contractor were reviewed and accepted at a final coordination meeting attended by representatives of the Study Contractor, FEMA, and the community.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Winfield, Lincoln County, Missouri. The area of study is shown on the Vicinity Map (Figure 1).

The areas studied by detailed methods were selected with priority given to all known flood hazard areas, and areas of projected development or proposed construction through November 1985. The scope and methods of study were proposed to and agreed upon by FEMA and the City of Winfield.

The limits of detailed studies in Winfield were first determined by representatives of FEMA, the Study Contractor and the City of Winfield during the meeting of November 28, 1978.

Floods caused by overflow from the Mississippi River and McLean Creek were studied in detail within the corporate limits.

2.2 Community Description

The City of Winfield is located in east-central Missouri in southeastern Lincoln County. About 48 miles northwest of St. Louis, the community encompasses an area of approximately a quarter of a square mile. Winfield is bordered on all sides by unincorporated areas of Lincoln County. State Highway 79 provides access to Winfield from the north or south and State Highway 47 provides access from the west. The Burlington Northern railroad provides rail transportation to Winfield. The industrial and commercial development is generally within one block of State Highway 79. The 1960 population of 565 increased to 620 in 1970 (Reference 1).

The City of Winfield was founded in 1879 by David T. Killam and named after his father, Winfield Scott Killam. The area where the city is now located was first settled by Sac Indians; then came explorers, fur trappers and traders, and finally, pioneers. A flour mill was built in Winfield in 1883, a tile factory was added in 1890, and later, a tomato canning factory was put into operation. The city was incorporated in February 1892 (Reference 2). The only industry now in Winfield is a cap-making factory.

Climate for the area is typified by the following temperature variations:

Season	Average High degrees Fahrenheit	Average Low degrees Fahrenheit
Winter	46	25
Spring	67	44
Summer	86	64
Fall	69	47

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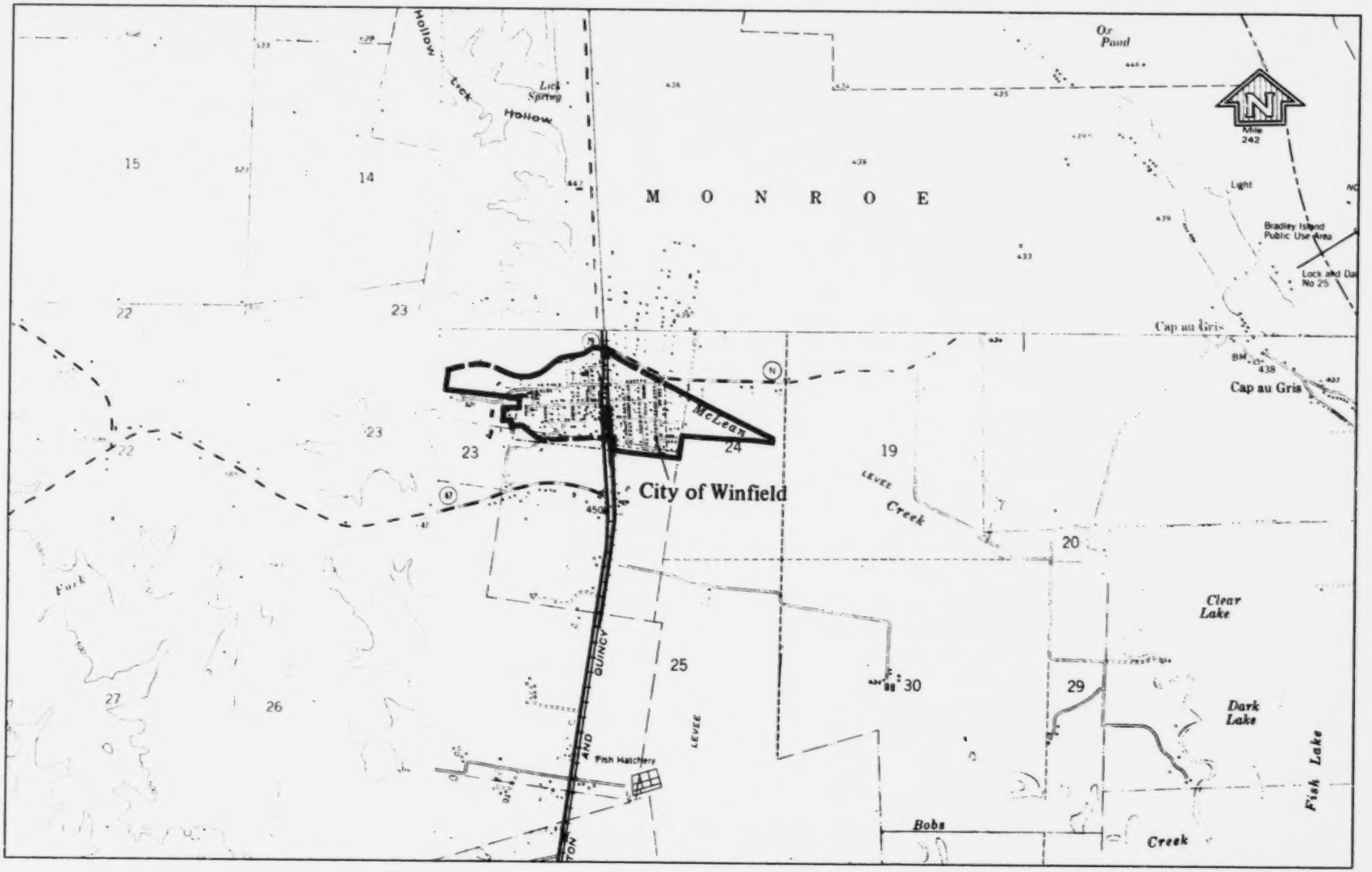

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WINFIELD, MO
(LINCOLN CO.)

APPROXIMATE SCALE
3000 0 3000 6000 9000 FEET

VICINITY MAP

Temperature extremes have ranged from -20 degrees Fahrenheit (F.) to 110 degrees F. Annual precipitation averages approximately 37 inches, distributed fairly evenly throughout the year. Monthly precipitation will vary from approximately 1.5 inches per month in December, January and February to 4.5 inches per month in May, June and September (Reference 3).

The topography of Winfield is flat in the eastern half of the city, but rises about 100 feet from State Highway 79 to the western corporate limits. Runoff from the community either drains into McLean Creek or flows into the Mississippi River flood plain east of the city. White Oak and Walnut timber is natural to this area. The city now contains some hardwood trees and other landscaping shrubs and plants.

Winfield lies on the edge of the Mississippi River alluvial flood plain. Surficial soils in the Winfield vicinity consist of 10-20 feet of silty clay loess. This is underlain by fine to medium sand which, in general, becomes coarser with depth. Depth to bedrock is 70 to 80 feet. Due to good vertical permeability of loess and the underlying sand, the area is well drained with moderately to gently sloping topography.

The area is underlain by Mississippian age limestones of the St. Louis, Salem and Warsaw formations. This area is located on the northern limb of the Troy-Brussels Syncline and the southern flank of the Cap au Gres Faulted Flexure. This geologic structure produces dips of 10 to 20 degrees toward the south (Reference 4).

McLean Creek, a tributary to Bob's Creek, flows east to west on the north side of the city. Development within the flood plain is primarily commercial and residential.

2.3 Principal Flood Problems

Past flooding in Winfield resulted from overflow of the Mississippi River and/or McLean Creek. In Spring 1973, flood waters from the Mississippi River covered the community east of the railroad tracks to about elevation 444.4 feet National Geodetic Vertical Datum (NGVD). The water was several feet deep in portions of this part of the city. This flood elevation was about 1.5 feet less than the 100-year frequency flood at this location. The city has also experienced flooding from McLean Creek overflows.

2.4 Flood Protection Measures

A private levee has existed for several years to keep flood waters out of the City of Winfield. It was overtopped during the 1973 flood. The levee has recently been raised approximately three feet above the level of the 1973 flood. The levee top is approximately 1.5 feet above the 100-year flood elevation, however it does not provide the required three feet of freeboard above the 100-year flood.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 per cent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (one per cent chance of annual occurrence) in any 50-year period is about 40 per cent (four in ten), and for any 90-year period, the risk increases to about 60 per cent (six in ten). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail affecting the community.

Peak discharge values for McLean Creek were developed by hydrologic basin modeling using Computer Program HEC-1 "Flood Hydrograph Package" (Reference 5). The computer program utilizes frequency rainfall amounts obtained from the U.S. National Weather Service Technical Paper No. 40 (Reference 6), unit hydrographs and storage routing. Discharges for the 500-year flood for McLean Creek were obtained by using rainfall extrapolated from that published in Technical Paper No. 40.

Flow frequency data for the Mississippi River were developed through the analysis of stream and rainfall gage records. Long-term discharge records for various key river gages were used to perform standard log-Pearson Type III statistical analyses (Reference 7). These key gages and their periods of record were Louisiana, Missouri, U.S. Army Corps of Engineers (COE) gage (1878 to date), Alton, Illinois, U.S. Geological Survey (USGS) gage No. 5875 (1904 to date) and St. Louis, Missouri USGS Gage No. 100 (1861 to date) (Reference 8). The flow frequency curves resulting from this study were then adjusted to reflect the upstream reservoir effects by reducing the flow values associated with each frequency. The reservoirs considered included the Missouri River Reservoirs and three Upper Mississippi Reservoirs - Coralville on the Iowa River, Redrock on the Des Moines River and Clarence Cannon on the Salt River. This adjustment reflected a major study in which numerous hypothetical and actual flood events were simulated by use of an analytical model to determine flood flows with and without reservoir control. Flow values from these adjusted flow frequency curves were used to determine the Mississippi River flood profiles.

Discharge for the 500-year flood was determined by straight-line extrapolation of a log-probability plot of flood discharges computed for frequencies up to 100 years.

Peak discharges for the 10-, 50-, 100-, and 500-year floods of each flooding source studied in detail in the community are shown in Table 1.

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQ MILES)	PEAK DISCHARGE (CFS) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
MCLEAN CREEK					
At confluence of Major Tributary, 1.63 miles upstream of State Highway 79	5.44	1900	4100	4600	5700
At State Highway 79	6.90	2500	5500	6200	7800
MISSISSIPPI RIVER					
At River Mile 241.2	142,000	290,000	375,000	410,000	500,000

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the streams in the community were carried out to provide estimates of the elevations of the floods of the selected recurrence intervals along each flooding source studied in detail.

Channel and valley cross sections for the backwater analyses of McLean Creek were obtained by photogrammetric methods (Reference 9). All bridges and culverts were field surveyed to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles. For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map.

Channel roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and based on field observations of the streams and flood plain areas. Roughness values on McLean Creek's main channel ranged from 0.055 to 0.065, and ranged from 0.045 to 0.080 for the overbank areas.

Starting water-surface elevations for McLean Creek were computed using slope-area method. Water-surface elevations of floods of the selected recurrence intervals for McLean Creek were computed through use of the COE HEC-2 step backwater computer program (Reference 10).

Water-surface profiles for the Mississippi River were developed by COE's Waterways Experiment Station using the Mississippi River Basin Model at Clinton, Mississippi. Profiles are representative of the present channel and flood plain conditions, with all levees, dikes, navigation structures and major landfills in place, using recent topographic data. Mississippi River profiles presented in this study were taken from the COE published report (Reference 11) of the above model. Channel and overbank roughness factors were simulated by analyzing aerial photographs and stage-discharge hydrograph data and adjusting roughness in the model. The entire model was verified by reproducing stages and discharges measured during the 1973 flood. The existing levee on McLean Creek does not provide a three-foot freeboard, therefore it has been considered to fail upon 100-year flooding and has not been considered in the modeling.

Flood profiles were drawn showing the computed water-surface elevations for floods of the selected recurrence intervals.

The hydraulic analyses for this study are based only on the effects of unobstructed flow. The flood elevations as shown on the profiles are, therefore, considered valid only if hydraulic structures, in general, remain unobstructed and if channel and overbank conditions remain essentially the same as ascertained during this study.

All elevations are referenced from National Geodetic Vertical Datum of 1929 (NGVD); elevation reference marks used in the study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by FEMA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100-year and the 500-year floods have been delineated using the elevations determined at each cross section; between cross sections the boundaries were interpolated using aerial photography at a scale of 1:4800 with a contour interval of four feet (Reference 9).

The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map. Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to lack of detailed topographical information or to limitations of the map scale, such areas are not shown. In cases where the 100-year and the 500-year flood boundaries are close together, only the 100-year boundary has been shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood may be carried without substantial increases in flood heights. Minimum standards of FEMA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plain. However, when there is insufficient conveyance in one of the overbank areas, the computer program automatically tries to reduce the conveyance on the other overbank area to make up the deficit. The results of these computations were tabulated at selected cross sections for each stream segment for which a floodway was computed (Table 2). Portions of the floodway for McLean Creek lie outside the corporate limits. No floodway was determined for the Mississippi River.

As shown on the Flood Boundary and Floodway Map, the floodway boundaries were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE
McLEAN CREEK							
A	2.930	529/130	3479	1.8	453.1	452.1	1.0

[1]MILES ABOVE MOUTH
[2]TOTAL WIDTH / WIDTH WITHIN CORPORATE LIMITS

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WINFIELD, MO
(LINCOLN CO.)

FLOODWAY DATA

McLEAN CREEK

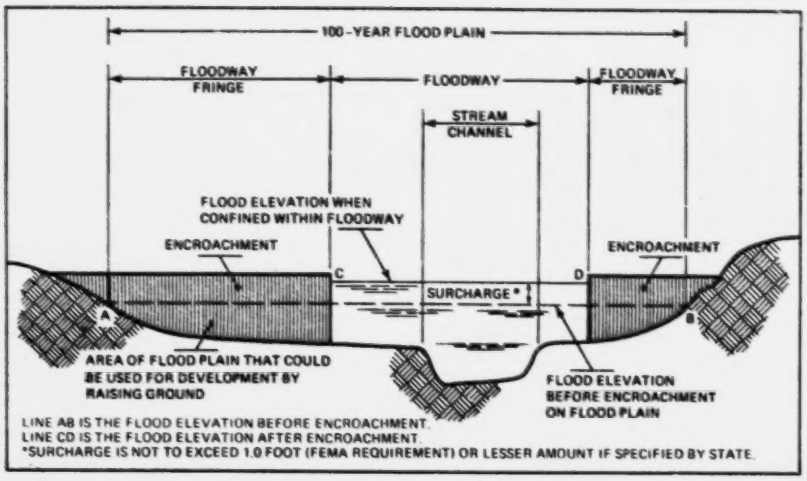
100-YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT.
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT.
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FIGURE 2 - Floodway Schematic

The floodways in this report are recommended to local agencies as minimum standards that can be adopted or that can be used as a basis for additional studies.

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, FEMA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHF), and flood insurance zone designations for each flooding source affecting the City of Winfield.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 per cent of the reach.

Average Difference Between 10- and 100-year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

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The locations of the reaches determined for the City of Winfield are shown on the Flood Profiles and are summarized in Table 3, "Flood Insurance Zone Data."

5.2 Flood Hazard Factors

The FHF is used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest 0.5 foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of the City of Winfield was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations are shown or FHFs determined.
Zones A6, A14:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations are shown, and zones subdivided according to FHF.
Zone B:	Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; or areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding.

Table 3, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Winfield is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by FEMA.

6.0 OTHER STUDIES

The COE, Rock Island District, has published a study on the Mississippi River (Reference 11). A Flood Insurance Study for the Unincorporated Areas of Lincoln County is currently in progress (Reference 12). These studies are in agreement with this Flood Insurance Study for the City of Winfield.

A Flood Hazard Boundary Map has been published for the community (Reference 13). The differences between the Flood Hazard Boundary Map and this study are justified due to the more detailed nature of this Flood Insurance Study.

This report either supersedes or is compatible with all previous studies published on streams studied in this report and should be considered authoritative for the purposes of the National Flood Insurance Program.

7.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, 911 Walnut Street, Kansas City, Missouri 64106.

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FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
MISSISSIPPI RIVER							
REACH 1[4]	0001	–7.1	–2.2	3.4	070	A14	446
McLEAN CREEK							
REACH 1	0001	–3.1	–0.3	1.0	030	A6	VARIES–SEE MAP

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT
[4]DATA FOR THIS REACH TAKEN FROM UNINCORPORATED AREAS OF LINCOLN COUNTY, MO. FIS

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WINFIELD, MO
(LINCOLN CO.)

FLOOD INSURANCE ZONE DATA

MISSISSIPPI RIVER - McLEAN CREEK

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11. ————, Rock Island District, Upper Mississippi River Water-Surface Profiles, 1979.

12. Federal Emergency Management Agency, Flood Insurance Study, Unincorporated Areas of Lincoln County, Missouri, (in progress).

13. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, City of Winfield, Missouri, July 1976.

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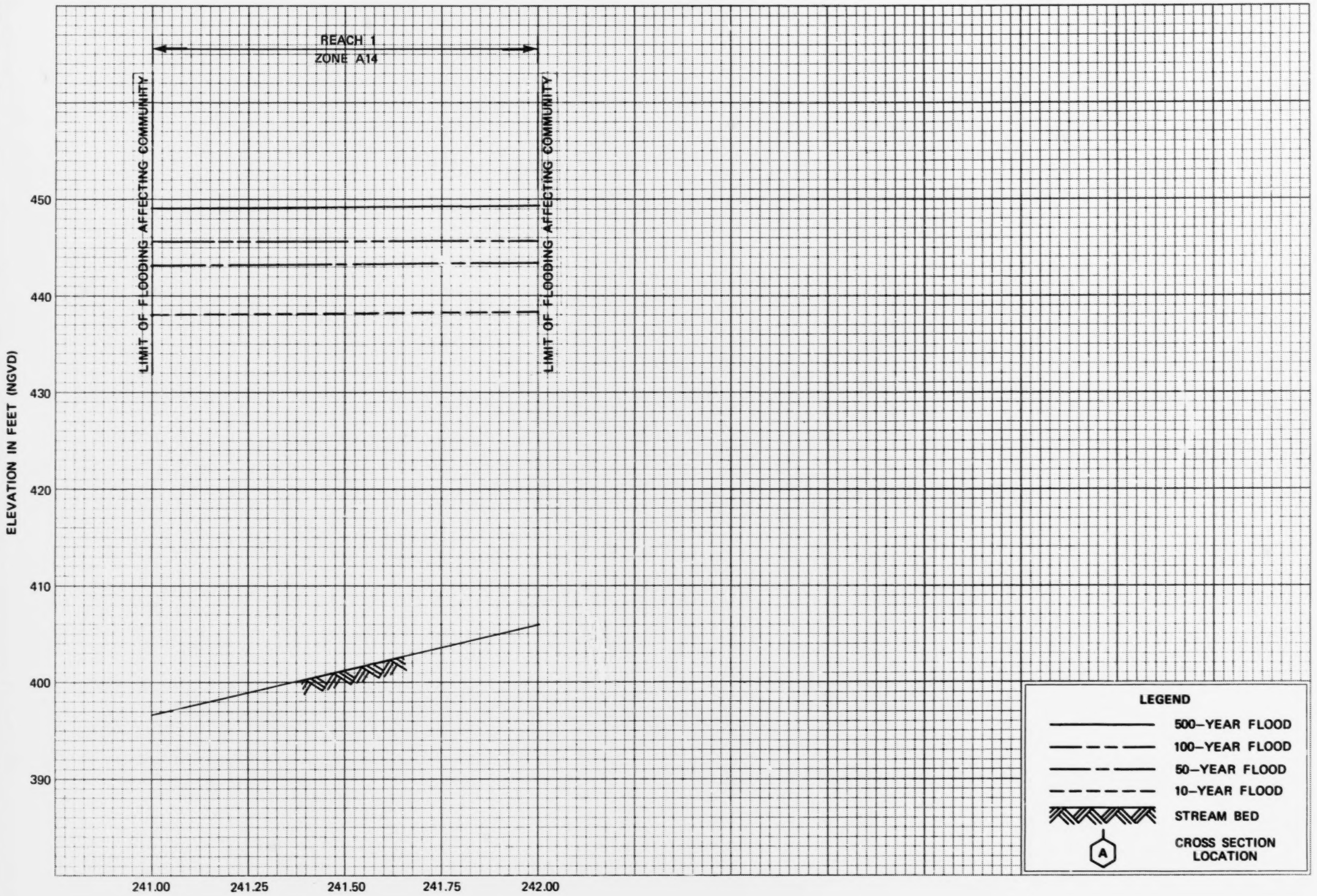

FLOOD PROFILES

MISSISSIPPI RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WINFIELD, MO
(LINCOLN CO.)

01P

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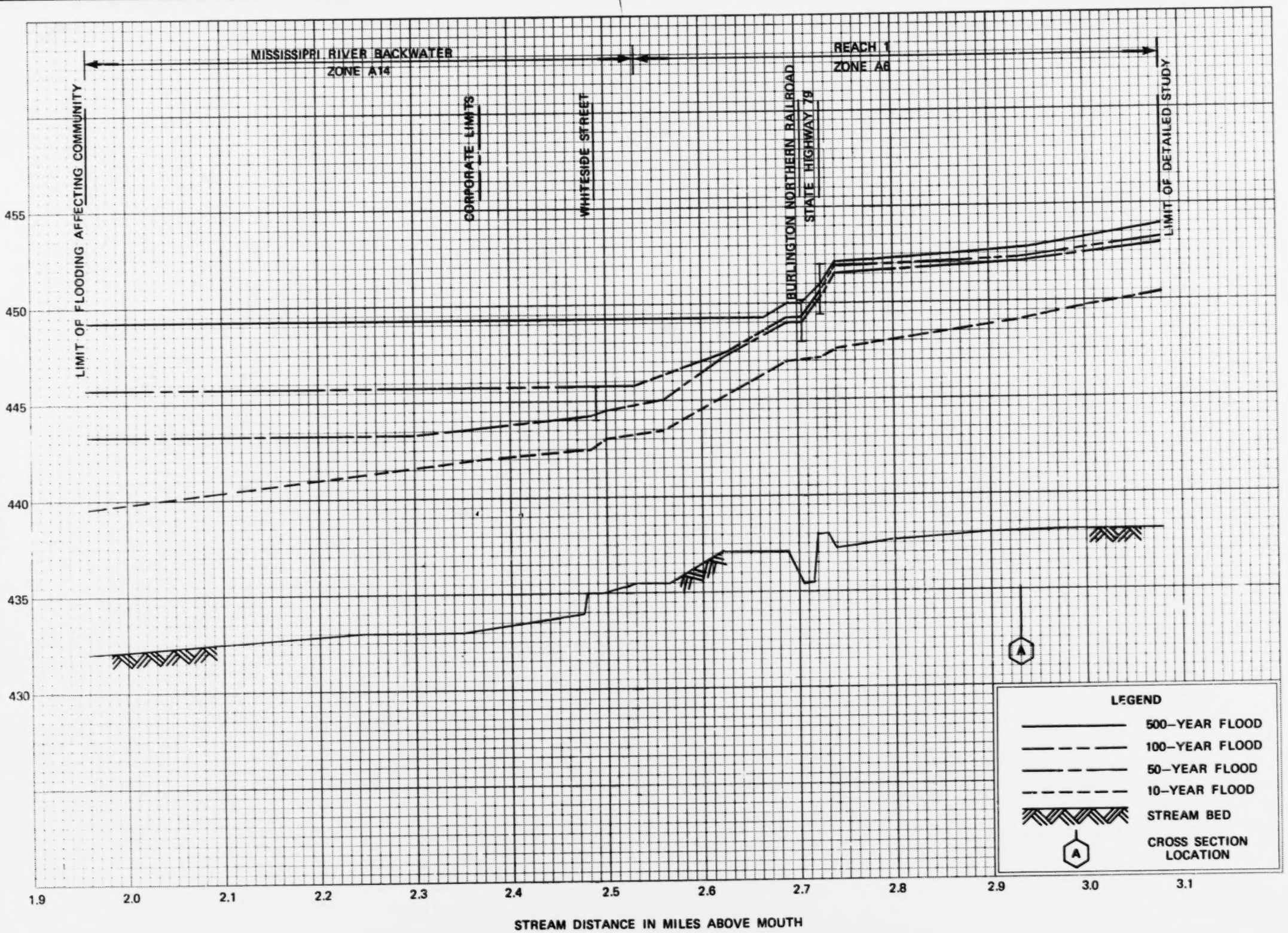

FLOOD PROFILES

McLEAN CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WINFIELD, MO
(LINCOLN CO.)

02P